REMARKS

Applicants wish to thank Examiner Addison for the for the courtesy and helpful comments extended during their recent interview of the application on August 13, 2008. Claims 1-20 are pending in the application. Favorable reconsideration in light of the remarks which follow is respectfully requested.

35 U.S.C. §102 Rejections

Claims 1-20 are rejected under 35 U.S.C. §102(e) over Akiyama (WO 03/103066). Applicants respectfully traverse.

Applicants teach piezoelectric devices in which a first electrode layer, a piezoelectric layer and a second electrode layer are laminated on a substrate in this order, and methods of manufacture of such piezoelectric devices. As set out, the piezoelectric layer is made of aluminum nitride and/or zinc oxide, and the piezoelectric layer has a degree of dipole-orientation of 55% or more.

Applicants unexpectedly found that in order to obtain piezoelectric elements having high piezoelectricity, the dipole-orientation of the piezoelectric layer is very important. For example, in a case where the degree of dipole-orientation is 50%, the occupancy of plus and minus become equal in the dipole direction on the surface of the piezoelectric film and no signal is sent out (see present application at page 16, lines 6-18). As noted by Applicants, however, it is very difficult to fabricate a thin film in which the degree of dipole-orientation is controlled (see , e.g. present application at page 5, lines 1-6).

The Office asserts in the Office action on page 4 that "Akiyama discloses the dipole orientation of the piezoelectric layer at (111) which is more than 55% (see page 6-11)."

As clarified during Applicants' August 13, 2008 interview, the cited Akiyama reference does **not** set forth dipole-orientation. However, it was clarified that it is the Office's position that

given the electrogravity (electronegativity) and crystal orientation of Akiyama's aluminum nitride films, Applicants dipole-orientation would be inherent. Applicants disagree.

Applicants first note that Akiyama (WO 03/103066) is a Japanese language document that corresponds to U.S. Patent No. 7,233,094. Nowhere in U.S. Patent No. 7,233,094 is any particular degree of dipole-orientation taught or suggested. Further, nowhere in the pages relied upon by the Office (page 6-11) or elsewhere in WO 03/103066 is it taught or even suggested that the piezoelectric layer has any particular degree of dipole-orientation, much less Applicants' claimed dipole-orientation of 55% or more. Thus, this feature, as noted during Applicants' August 13, 2008 interview, is not expressly disclosed by Akiyama.

Further, Applicants submit that Akiyama does not inherently disclose this feature. As it has been well-established, in order for a reference to inherently disclose a feature not expressly disclosed, extrinsic evidence can be used to supply the missing feature only if the extrinsic evidence "make[s] clear that the missing descriptive matter is *necessarily present* in the thing described in the reference and that it would be so recognized by persons of ordinary skill in the art. Inherency, however, may not be established by probabilities or possibilities." MPEP 2112(IV), citing *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999) (citations omitted) (emphasis added).

According to Akiyama, a piezoelectric film is made of "c-axis-oriented alumina nitride thin film having a rocking curve full width half maximum (RFC-WHM) not exceeding 2.5°." (see, e.g. Abstract; col. 2, lines 27-30, 46-48, and 60-62; col. 3, lines 4-7, 27-31, 45-47; col. 5, lines 43-54). As specified:

> The piezoelectric body thin film of the present invention is made of a super-c-axis-oriented aluminum nitride thin film with a rocking curve full width half maximum (RCF-WHM) of 2.5° or less. Rocking curve measurement gives the deviation and range of the orientation of the crystal plane. Referring to FIG. 13, there exists a correlation between the RCF-WHM and the electric charge stored in a piezoelectric element. The piezoelectric element stores more electric charge and shows better performance, with smaller RCF-WHMs. In the present invention, the super-c-axis-oriented aluminum nitride thin film is

> defined as the aluminum nitride thin film with a RCF-WHM of 2.5° or less. (Akiyama, col. 5, lines 43-54)

However, piezoelectric elements having a RFC-WHM not exceeding 2.5° (as required by the cited Akiyama reference) do not inherently possess Applicants' claimed degree of dipole-orientation. In particular, a piezoelectric element having a RFC-WHM of 2.2° on a Cr/Pt bottom electrode has a high degree of crystal orientation but a low piezoelectricity of 0.1 pC/N, and a degree of dipole-orientation of 50% (thus, clearly not in accordance with Applicants' claims). Further, piezoelectric elements having a RFC-WHM exceeding 2.5° (and, thus, not in accordance with the Akiyama reference's requirements) have been found to possess a high degree of dipole-orientation. In particular, a piezoelectric element having a RCF-WHM of 8° on a molybdenum bottom electrode has a low degree of crystal orientation but a high piezoelectricity of 5 pC/N, and a degree of dipole-orientation of 100%.

Thus, it follows that degree of dipole-orientation of 55% or more is not an inherent property of Akiyama's piezoelectric elements.

Applicants further note, with respect to electronegativity and crystal orientation - upon which the Office relies for its inherency argument – that, as set forth in Applicants' disclosure, (1) it is desirable that the electronegativity of a metal forming the lower electrode ranges from 1.3 – 1.5, and that such electronegativity values make it possible to form a film having a high degree of dipole-orientation (see, e.g. present application at page 14, lines 11-23), and (2) it is more desirable that a metal for forming the lower electrode has a crystal face whose atomic arrangement is the same as the face of the piezoelectric film because this allows the aluminum nitride and zinc oxide to grow without warps when the piezoelectric film is formed, and accordingly the piezoelectric film can be formed with a high degree of dipole-orientation (see, e.g. present application at page 14, line 24 –page 24, line 9). However, such statements are insufficient to support a conclusion that a film provided with one or more of these properties will inherently possess Applicants' claimed degree of dipole-orientation – particularly in view of Akiyama's requirement for a c-axis-oriented alumina nitride thin film having a RFC-WHM not exceeding 2.5° as discussed above.

Applicants have unexpectedly discovered that in order to obtain a high piezoelectricity, a piezoelectric layer having a degree of dipole-orientation of 55% or more (as recited in Applicants' claims) is more important than a piezoelectric layer formed of a c-axis-oriented alumina nitride thin film having a RFC-WHM not exceeding 2.5° (as required by Akiyama).

Clearly, each and every element of Applicants' independent claim 1 is not found, either expressly or inherently, in the Akiyama reference and, as such, the Office's 35 U.S.C. §102(e) rejection in view of Akiyama is improper. Thus, independent claims 1 and 13, and all claims dependent therefrom, are not anticipated by Akiyama.

Further, there is absolutely no teaching, suggestion, or motivation to modify Akiyama so as to provide Applicants' claimed piezoelectric layer having Applicants' claimed properties. Rather, this teaching comes purely from Applicants' disclosure, and such a modification of Akiyama would clearly be the result of impermissible hindsight reasoning.

In view thereof, Applicants respectfully submit reconsideration and withdrawal of the rejections.

CONCLUSION

In view of the above amendment, applicant believes the pending application is in condition for allowance. Early and favorable action is requested. If for any reason a fee is required, a fee paid is inadequate or credit is owed for any excess fee paid, you are hereby authorized and requested to charge Deposit Account No. **04-1105**.

Dated: September 2, 2008

Respectfully submitted,

By /Lisa Swiszcz Hazzard/

Lisa Swiszcz Hazzard
Registration No.: 44,368
EDWARDS ANGELL PALMER & DODGE LLP
P.O. Box 55874
Boston, Massachusetts 02205
(617) 517-5512
Attorneys/Agents For Applicant